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CHRISTOPH (H.). **Untersuchungen über die mykotropen Verhältnisse der Ericales und die Keimung von Pirolaceen.** [Researches on the mycotrophic relations of the Ericales and the germination of the Pirolaceae.]—*Beihefte Bot. Centralbl.*, xxxviii, 2, pp. 115-157, 1 pl., 1921.

The mycorrhiza of *Erica carnea* and *Calluna vulgaris* are stated to be produced by soil fungi. Experiments with cuttings planted out in flower-pots showed that in soil sterilized by heat the roots remained perfectly sterile, while in ordinary heath-soil rich in humus the entire root-system was affected. Both sterilized and unsterilized seeds of both genera gave plants whose roots remained entirely free from mycorrhizal fungi when grown in thoroughly sterilized soil. Plants from unsterilized seeds grown in ordinary soil rapidly exhibited the characteristic formation of mycorrhiza. Permanently sterile plants of both *Erica* and *Calluna* can easily be cultivated, and grow as vigorously as those provided with mycorrhiza, but when the fungus is present it does not appear to exercise any harmful effect. It is entirely absent from plants grown in dry soil without humus. The fungus was isolated and grown on a medium consisting of peat with an admixture of 10 per cent. of gelatine. It forms a sterile mycelium, which is capable of producing the typical fungous growth in the roots. Mycorrhiza are also found in many other members of the Ericaceae when grown in humus-rich soils.

In the case of the Pirolaceae the fungus also comes from the soil. Infection does not, however, occur by means of the penetration of the external epidermal cell-walls, as in *Erica* and *Calluna*, but the hyphae enter between the epidermal cells and form an intercellular mycelium. The cells of the epidermis are only subsequently penetrated from within. The mycorrhiza of all the species of *Pirola* examined are thought by the author to be produced by the same fungus, the hyphae of which possess clamp-connexions.

An examination of the root-system of the Monotropoideae (a subdivision of the Pirolaceae), showed that their subterranean vegetative organs are less extensive than those of *Pirola*. The fungus, which is clearly a distinct species, without clamp-connexions, forms

a rather loose fungous sheath from which numerous hyphae extend into the substratum, and presumably act as organs for the conveyance of nutriment. This is the only case in which there appears to be any evident exchange of nutrition between the fungus and the root. In the other cases the fungus is not considered to have any part in supplying nutriment to the roots. It is a 'harmless parasite'.

Ectotropic fungous development occurs only in those species of *Pirola* whose subterranean system is divided into rhizomes and roots, and then exclusively in soil with a rich humus content which leads to an extensive ramification of the roots. The external fungous growth arises from the intercellular mycelium only after the epidermal cells are filled with hyphae, and it has no direct connexion with the substratum. When the youngest lateral, or feeding, roots are completely enveloped they cease to function and die. The plant does not suffer, since it is able to substitute one of the embryo roots situated on the rhizome. In the Ericaceae also the ectotropic growth only develops in species which form a coral-loid root-system in rich soil, and the fungus lives at the expense of the epidermal cells in a similar fashion.

The seed of *Pirola rotundifolia*, the root-system of which shows the most pronounced association with the fungus in certain localities, germinates independently of the fungus, and the same is presumably true of other allied species, since otherwise they could not develop at all in dry soil where the fungi concerned are absent. Further germination studies are in progress.

DUFRENOY (J.). **Bactéries anaérobies et Gommose du Noyer.** [Anaerobic Bacteria and gummosis of the Walnut.]—*Comptes rendus de la Soc. de Biol.*, lxxxiv, 3, p. 132, 1921.

For some years walnut-trees of all ages in the Pyrenees and vicinity have been attacked by a disease resulting in the destruction of entire groves. The first symptoms are a cracking and desiccation of the cortex of the collar, and the decay of the roots, beginning at the extremity, which is of a deep black colour. The cortex is easily detachable. At the other end of the root-system, not yet blackened, mycelial hyphae penetrate the fibres, stopping up the cells of the medullary rays and producing brown or greyish swellings (? arthrospores or conidia).

Sections through the collar or roots show numerous cells (displaced in the cambium, the wood, or especially the pericycle, and sometimes grouped at the brown edges of the radical cankers), filled with yellowish-brown gum. They are detached at the angles by the solution of the middle lamella, while the membrane turns brown. Fragments of gummy, unblackened roots, externally sterilized and then split, were placed on the surface of agar with peptonized glucose, or immersed in it. No cultures were obtained from the parts exposed to the air, but colonies of grey bacteria developed in the depths of the agar, extending as far as the bottom of the tubes. It is impossible to tell as yet whether these bacteria are responsible for the death of the walnuts, or whether they are secondary parasites penetrating by means of lesions such as frost cankers.

HENNING (E.) & LINDFORS (T.). **De viktigare Potatissjukdomarna.** [The principal diseases of the Potato.]—Reprinted from *Landtmannen*, 34 pp., 11 figs., 1921.

A popular account of the chief potato-diseases of Sweden due to fungi, bacteria, and physiological causes, with directions for their treatment. The diseases enumerated include 'felt-disease' (*Hypochnus* or *Rhizoctonia solani*), fusariosis, verticilliosis, blight (*Phytophthora infestans*), wart disease (*Synchytrium endobioticum*), corky scab (*Spongospora subterranea*), true scab (*Actinomyces scabies*), stem bacteriosis (*Bacillus phytophthorus*), ring bacteriosis, bacterial soft rot, leaf roll, and curly dwarf.

WEISS (F.) & ORTON (C. R.). **Second report on the reaction of American Potato varieties to the Wart disease.**—Abs. in *Phytopath.*, xi, 1, p. 57, 1921.

Seventy-eight varieties of potato have been tested and twenty-seven found to be immune. Foreign immune varieties also remain immune in the United States. American immune varieties include several very widely grown commercial varieties such as Irish Cobbler, Early Petoskey, Spaulding Rose, Burbank, and Green Mountain.

WEISS (F.) & HARVEY (R. B.). **Catalase, hydrogen-ion concentration, and growth in the Potato Wart disease.**—*Journ. Agric. Res.*, xxi, 8, pp. 589-592, 1921.

The H⁺ concentration of wart tissue is greater than that of healthy tissue (P_H 6.00 and P_H 6.49 respectively). Catalase activity is much greater in wart tissue than in healthy (17.9 as against 7.8 c.c. of O₂ evolved respectively). Differences in acidity of the varieties are not associated with immunity to the disease.

COLLINS (E. J.). **The problem of the inheritance of immunity to Wart disease in the Potato.**—*Gardeners' Chron.*, lxx, pp. 260, 271, 290, 314, and 326, 2 figs., 1921.

The author, writing from the John Innes Horticultural Institution, outlines the experiments being carried out by him there, and in the Ormskirk potato trials, relative to the inheritance of wart disease.

Although potatoes are commonly listed only in the groups 'immune' and 'susceptible' to wart, there should be an intermediate group if the inheritance follows Mendel's laws. The immune group includes those forms which would produce only immune plants if seeds from self-fertilized flowers were planted. To such plants could be assigned the constitution RR. It was found impossible on account of absence of pollen or early dropping of the flowers to obtain selfed seed of the following immune varieties:—Golden Wonder, Langworthy, Dargill Early, Favourite, Conquest, Arran Comrade, Sutton's A 1, Witch Hill, and others. Selfed seedlings of Leinster Wonder, Shamrock, and Majestic were discarded because of lack of vigour and yield.

Susceptible varieties may be designated SS. Selfing tests cannot be made for the same reasons as in the last group with Up-to-date, British Queen, Arran Chief, King Edward, Macpherson,

Snarpe's Express, Eclipse, Harbinger, Ninety-fold, and Midlothian Early, but could be made with President, Edgecote Purple, and Myatt's Ashleaf. The author has done so with the last two, but the seedlings were poor and were discarded.

Intermediates, SR or RS, should occur when crosses of resistant and susceptible varieties are made. Crosses are impossible between certain potato varieties because of lack of viable pollen, failure to flower, &c., but special treatment of the plants may sometimes in part overcome these difficulties.

A discussion of expectations in case of dominance or of recessiveness of immunity is given, and some results published by Wilson (*Trans. Highland Agr. Soc., Scotland*, 1916) are analysed. The results are then given of some crosses made in 1916, the progeny being grown at Ornskirk in 1919. Defiance (R) \times Edgecote Purple (S) gave three susceptible and one resistant seedlings; Macpherson (S) \times Defiance gave six seedlings all S; Defiance \times Leinster Wonder (R) gave five R seedlings; Macpherson \times Leinster Wonder gave two R and one S seedlings. *Solanum edinense* was found to be immune. The evidence is considered to indicate the dominance of susceptibility.

MELHUS (I. E.) & GILMAN (J. C.). **Measuring certain variable factors in Potato seed treatment experiments.**—*Phytopath.*, xi, 1, pp. 6-17, 1921.

Formaldehyde or mercuric chloride solutions, as ordinarily used, do not kill all the scab (*Actinomyces scabies*) or black scurf (*Rhizoctonia solani*) organisms on potato tubers. Cultures in the laboratory may be made to forecast the effect of treatment in the field. Mercuric chloride may exert only an antiseptic, but not a completely disinfecting action on sclerotia of *Rhizoctonia*, in that penetration of the poison is not sufficient to kill the hyphae in the centre of the sclerotia. As a rule, when the laboratory data showed a large percentage of viable sclerotia after treatment, the field counts gave a high percentage of infected tubers from seed treated in the same manner.

Since both these organisms may exist in the soil, a considerable number of checks must be run in order to obviate so far as possible misinterpretations from this variable factor.

KUWATSUKA (K.). **Some studies on the *Pseudomonas Pruni* E. F. Smith.**—*Annals Phytopath. Soc. Japan*, i, 4, pp. 12-19, 1921.

The author carried out a series of inoculation experiments with this organism on sixteen genera of Rosaceae, including the plum and peach. Strains were isolated from various sources, including the leaf, branch, and fruit of diseased peach and plum trees. These strains were proved to cause not only shot-hole disease of the leaf but also black spot of plum fruit. Infection occurred with strains isolated from hibernated diseased branches in early spring, as well as from branches in the autumn and fruits in the summer. This suggests that the viability of the organism in the infected tissue of a twig is not destroyed during the winter under

field conditions, and such branches may serve as a source of infection in the spring.

The plants previously recorded as hosts of *Ps. pruni* are the apricot, nectarine, peach, plum, and Wragg cherry (*Prunus cerasus* L.). All varieties of these plants are not, however, equally attacked, the susceptibility and resistance to natural infection varying according to the variety. From the results of his inoculation experiments the author states that almost all species of *Prunus*, wild and cultivated, are liable to attack. He obtained successful infection on apricot, plum, peach, nectarine, *Prunus avium* (stem only), *P. buergeriana* (stem only), *P. crassipes*, *P. donarium* subsp. *elegans* var. *glabra* (stem only), *P. japonica*, *P. mume*, *P. mume* var. *microcarpa*, *P. mume* var. *bungo*, and *P. triflora*. *Sorbus japonica* was the only host outside the genus *Prunus* that was successfully inoculated. Excessive soil moisture seems to be an important factor in increasing liability to infection, having much more effect than high atmospheric humidity. The author suggests that as leaf infection occurs through the stomata, soil moisture may act by influencing the degree to which these are opened. Attention to drainage is probably an important point in the treatment of the disease.

TISDALE (W. H.). **Two Sclerotium diseases of Rice.**—*Journ. Agric. Res.*, xxi, 9, pp. 649-657, 5 pl., 1921.

SCLEROTIIUM ROLFII SACC. Forms of this disease occur in Louisiana on soy-bean, wheat, and tall oat grass (*Arrhenatherum elatius* L. (Beauv.)), as well as on rice, but although in culture the organisms appear slightly different morphologically, this difference does not warrant their being classed as distinct species. An apparently identical sclerotial disease of rice occurs in the Philippines.

On rice it is not a vigorous parasite. It attacks germinating seed and the roots of young seedlings in various stages of growth, many having been found destroyed before emergence from the soil. The fungus requires a free supply of air for its growth, and consequently does more damage to seedlings when the soil is rather dry. Its distribution is not known, but considerable losses may result in localities where it occurs. Investigations carried out at Crowley, La., showed that early sown rice seems more subject to attack than that sown later, as the latter germinates more readily and the plants grow more vigorously, thus giving the fungus less chance to overcome them before the irrigation period. It has been established that water checks the development of the fungus, and unless plants attacked by it are too far gone they will usually readily recover under irrigation. But the fungus is only checked, not killed, by this treatment.

The decayed roots showed small, brown, spherical sclerotia, while the typical, rather coarse, white mycelium was present on these parts, and in the soil immediately surrounding them. The fungus remains in the sclerotial stage during seasons that are unfavourable to growth. Sclerotia, even under adverse conditions, retain their vitality for considerable periods, and kept dry they germinate readily after nine months when placed in congenial surroundings.

The mycelium will live for a long time in the infected plant tissues, and also in the soil where there is sufficient organic matter to furnish food.

Dissemination may be effected by the sclerotia, which float on the surface of water like cork, and can easily be carried by the irrigation flow. The fungus also grows vigorously as a saprophyte, and may be carried on old straw or other plant material.

If the disease begins to develop, the field should be irrigated as soon as possible. If the soil is known to be infected, it should be irrigated sufficiently to wet it thoroughly at the time the seed is germinating.

While the forms from soy-bean and tall oat grass did but little damage to rice, it is suggested that adaptation accomplished through more or less prolonged contact with the rice plant may render them more parasitic.

STEM ROT CAUSED BY *SCLEROTIUM ORYZAE* CATT. This disease was observed at Crowley, La., in 1919 and 1920, and has also been met with in various other localities in the United States, while in Italy it has been known for years, and several districts in India and Japan have reported damage from it.

There are indications that the sclerotia float on the water, and thus come in contact with the leaf-sheath—which is the first part of the plant to be attacked—where they germinate and penetrate the tissues, causing dark-brown areas. These lower sheaths die when submerged in the irrigation water, the fungus living more or less as a saprophyte at first in the dead tissues, and finally attacking the stems after the plants are older. Two or three nodes from the base the stem appears darker, and the internode where the irrigation water stands is almost completely destroyed, only the thin epidermal layer remaining intact; the stem at this point is often completely collapsed so that the plants lodge readily. In the cavity of the diseased portion of the stem and in the diseased tissues a web of fine white mycelium and numerous small, black, and rather uniformly spherical, smooth-surfaced sclerotia are found. The hyphae are 3 to 5 μ in diameter, septate, and profusely branched. When the sclerotia are dry and mature they range in size from 220 to 270 μ in diameter, averaging about 250 μ .

The most severe damage is caused at the time the vitality of the stem is declining and the panicles are filling. The latter are poorly filled and light. According to Shaw and Butler, in India the diseased plants produce tillers, a condition which is not observed to any great extent in Louisiana, but may be due to earlier attacks by the fungus in India.

The means of dissemination are the same as for *Sclerotium rolfsii*, and survival takes place during the winter and other periods unfavourable to growth in the sclerotial stage.

PETCH (T.). *The Diseases and Pests of the Rubber Tree*. x + 278 pp., 6 col. pl. and 38 text-figs., London, Macmillan & Co., 1921.

The present work is a revised and greatly enlarged version of the section devoted to pathological problems in the author's well-known book, *The Physiology and Diseases of Hevea brasiliensis*, which

appeared in 1911. Attention is drawn in the preface to the fact that the future of plantation rubber is largely dependent on the effective control of disease, and that the importance of this factor both in its effects on cultivation and in its research aspect can hardly be exaggerated.

The opening chapter deals with general sanitation, and emphasizes the necessity for a thorough clearance in new plantations of jungle stumps and fallen timber, which are such a fruitful cause of root disease. Thinning out in Ceylon is now taking place on a scale which leaves about eighty to one hundred rubber trees to the acre, and it is probable that ultimately the number will not exceed sixty. Alternative methods of planting are considered at some length, the author's conclusions being that the trees should be planted at the distances at which they are intended to stand. This would obviate the disadvantages of close planting, which leads to poor bark renewal, diminished yield as the tree grows older, and greater prevalence of disease, as well as the labour and expense of subsequent thinning out, with the inevitable risk of root diseases developing from the *Hevea* stumps and logs.

Great interest attaches to the question of intercropping and cover plants, and the comparative merits are discussed of cacao, coffee, and tea for the former, and *Crotalaria striata*, *Tephrosia candida*, *Albizia moluccana*, and the thorny dadap for the latter. From the mycological standpoint, cacao is the worst possible intercrop for rubber, of which it shares many of the diseases. Directions for pruning, scraping, forking, tree surgery, and the protection of wounds are included in this section.

Referring next to the six root diseases hitherto recorded (*Fomes lignosus*, *F. lamaoensis* (*Hymenochaete noxia*), *F. pseudo-ferreus*, *Poria hypobrunnea*, *Ustilina zonata*, and *Sphaerostilbe repens*), the author gives a detailed account of their causes and symptoms, together with methods of treatment. He thinks that there is, generally speaking, little hope of saving a tree attacked by a root disease, and such operations as trenching are undertaken mainly to prevent the spread of infection.

Writing in 1911, the author remarked that rubber was not subject to any serious leaf disease. This would now, as he points out, be a grave misstatement, two diseases having made their appearance which threaten the entire future of the rubber industry. One of these, *Fusicladium macrosporum* (*Melanopsammopsis uli*), is at present confined to South America. The abnormal leaf-fall caused by *Phytophthora* and associated with excessively heavy rainfall occurs in India and Ceylon, and probably in Java also, and is the most serious leaf disease of rubber as yet known in the East. A less severe type of leaf-fall is caused in Ceylon by *Gloeosporium alborubrum*. Both these last diseases are associated more or less closely with a fruit rot. The symptoms of other *Phytophthora* diseases are described, and suggestions made for treatment. Pink disease (*Corticium salmonicolor*) and die-back (*Botryodiplodia theobromae*) are also treated at length. *Kretzschmaria microspora* Berk., a fungus that does not seem to have been recorded previously on *Hevea*, is described as a wound parasite of stems which produces similar effects to the stem attacks of *Ustilina zonata*.

A chapter is devoted to diseases of a physiological character and other abnormalities, such as globular shoots, fasciations, cork warts, nodules, &c. Chief among the non-parasitic diseases is brown bast, due to some interference with the normal physiological functions of the tree, or occurring in response to some condition induced by tapping. It has not yet been found possible definitely to correlate the incidence of brown bast with the frequency of tapping, or the yield of the tree, or prolonged tapping on one section. The percentage of disease, however, appears to be lower in Ceylon, where the alternate-day system of tapping is practised, than in countries where daily tapping is in vogue.

In the section on prepared rubber, the causes and effects of spotting and flushing are discussed. With the introduction of improved methods of drying, the occurrence of these discolorations has been greatly reduced. The various types of spots and flushes are described and their prevention discussed. The development of 'rust', surface moulds, and tackiness is also dealt with, and it is held that the question of the effect of spraying with Bordeaux mixture on the rubber prepared from treated trees requires further investigation.

Insect pests are described, and the author concludes with a chapter on miscellaneous preservatives and disinfectants, with directions for their preparation. In discussing izar, a 20 per cent. solution is mentioned for bark treatment, and considered to be unsafe, but this is much above the strength ordinarily used and recommended by the makers, who state that 5 per cent. need never be exceeded.

The book is illustrated with fine coloured plates and excellent photographs, and a good bibliography and index are appended.

HOHNGAARD (J.). **Undersøgelser vedrørende saasæds sortsæghed og frihed for brand og stribesygge. 1917-20. Beretning fra Statsfrøkontrollen.** [Investigations on the purity of strain and freedom from smut and stripe disease of seed-grain. Report of the Danish State Seed Testing Station.]—*Tidsskrift for Plantavl*, xxvii, 4, pp. 553-599, 8 figs., 1921. (English summary.)

During the period under review the following samples were tested: 482 of two-rowed barley, 71 of six-rowed barley, 317 of oats, 17 of wheat, 2 of rye. In addition to laboratory tests for purity, content of foreign seed, and rate and power of germination, field tests (15,000 plants as indicator, 30,000 plants as guarantee, sown at two experiment stations at two different seasons) were carried out to determine the germinating power and the presence of *Pleospora graminea* and various smuts, namely, *Ustilago nuda*, *U. hordei*, *U. avenae*, *U. levis*, *U. tritici*, *Tilletia caries*, and *Urocystis occulta*. With the exception of Tystofte cross barley, most of the barley samples were attacked by *Pleospora graminea* (0.1 to 480 per thousand), the Prentice strains and Karls barley being the worst, while 122 of 499 samples (25.6 per cent.) showed a figure per thousand in excess of that for which compensation is paid for guaranteed seed samples. Svalöf Gold and Abed Binder barley were more affected with *Ustilago nuda* than Prentice, which, how-

ever, had more *U. hordei*. Both these smuts were much less prevalent than the stripe disease fungus. *U. avenae* was most severe on Yellow Naesgaard, Svalöf Victory, and Lyngby Heath oats; Svalöf Crown being the freest. The incidence of this disease varied between 0.1 and 61 per thousand. Wheat samples treated with copper sulphate or hot water were practically free from *Tilletia caries*.

RANDS (R. D.). **Brown Bast disease of plantation Rubber, its cause and prevention.**—*Meded. Inst. voor Plantenziekten*, 47, 57 pp., 5 pl., 1921.

Brown bast, which has only been recently recognized as a separate and distinct disease of *Hevea brasiliensis* though probably present since the tree was introduced in the East, is an affection of the bark of tapped trees, involving the discoloration of the inner bark and the stoppage of the latex flow. The bark is not killed, however, the diseased trees often being characterized by irregular overgrowths known as 'burrs'. The severity of the disease in the East Indies and Federated Malay States has led to much investigation, certain aspects of which have already been published by the writer (Progress report on brown bast (read before the Rubber Growers' Association), *Nedert.-Ind. Rubber-tijdschrift*, iv, pp. 157-158, 1919; Bruine binnenbast en tapproeven, *Alg. Landh. Weekblad Nederl.-Indië*, iii, pp. 1592-3, 1919; De bruine binnenbastziekte van *Hevea brasiliensis*, *Arch. voor de Rubbercult.*, iii, pp. 156-159, 1919). Further histological and microchemical studies will shortly be published [see next abstract].

Brown bast disease is generally easily recognized by a partial or complete dryness of the tapping cut (i. e. stoppage of the latex flow), accompanied by a greyish to greenish-brown discoloration in the middle and inner bark. In severe cases the discoloration may at first be confined to narrow parallel lines following the rows of latex vessels. Successive inspections at intervals of five to ten days are necessary to detect the disease in the incipient stage, since the symptoms may otherwise be confused with a normal unevenness of flow which occurs during the dry season or at a period of leaf change. The dryness of the cut is sometimes preceded by an unusually large yield of thin latex with a low rubber content, or there may be unevenness of scrap on the cut resulting from unequal duration of flow. This latter symptom may be regarded as a reliable warning of the presence of the disease. Care must be taken not to mistake a superficial brown or blue discoloration of the tapping cut occurring in very wet weather for a symptom of brown bast, since it is nothing more than a case of local wound response.

There may be no outward manifestation of the disease, even in advanced cases, the bark remaining smooth and development proceeding normally. A deep cut, however, will reveal lack of latex, dryness, and discoloration. Mere pricking the bark is not a satisfactory criterion, since there is normally a flow of latex from the few healthy rows next to the cambium.

Other severe cases, however, pursue quite a different course, a longitudinal cracking of the outer bark and exudation of latex taking place after a few weeks or months. This condition is due to the formation of woody nodules (the 'burrs' referred to above)

in the diseased bark, which finally becomes too irregular to be of any further use for tapping.

No cases of brown bast on untapped trees are known to the writer, though similar discoloration is reported on trees injured by fire.

From the planter's point of view, brown bast is certainly the most serious disease affecting the Pará rubber tree. Loss through decreased production is the chief item, though the expenditure on inspection, treatment, and thinning out is also heavy. The highest producing trees are generally claimed to be the most susceptible. In some plantations as many as 50 to 85 per cent. of the trees are affected, and the writer has seen 15,000 trees out of tapping on account of brown bast in a Java estate. This represented an average monthly loss in yield of 2,000 kg. of dry rubber, and it is probably safe to estimate a financial loss of several million guilders per annum from the 750,000 acres or more under rubber in the Dutch East Indies.

The writer has found a proportion ranging from 0.3 to 85 per cent. of brown bast in the forty odd plantations inspected by him in Java and Sumatra. These variations are probably due to differences in the tapping system, the amount and methods of thinning, elevation, climate, and soil conditions. The Ceylon method of tapping, i. e. one cut on one half the circumference every other day, appears to be the most satisfactory as regards brown bast disease, less than 3 per cent. of affected trees being usually found on estates where it was in use. The disease appears to be particularly severe in the Federated Malay States, where daily tapping has long been the rule. A general adoption of less drastic methods is following upon the recognition of a connexion between tapping and disease, and a corresponding improvement in the condition of the trees may therefore be expected.

Diseased areas of bark in all stages were microscopically examined for a possible causal organism. The yellowish gummy substance described later was found in every case, occupying many of the latex vessels and intercellular spaces. This suggested a bacterial agency, but neither constancy of occurrence nor the results of inoculations suggest that the organisms found can be the cause. The protoplast of the latex vessel is apparently the only element in ordinary diseased bark which actually dies. Endeavours were made to transmit the infection from diseased to healthy trees, freshly diseased bark being brought into contact with healthy plants. The outcome of all these experiments under different conditions was negative. These results lead to the conclusion that brown bast is not caused by a parasite and is not a transmissible disease. Similar negative results are reported by several earlier investigators.

The diseased tissues contain a deposit of a yellowish gum-like substance, which impregnates the membranes, fills intercellular spaces, and clogs the latex vessels. It is this substance which causes the discoloration and cessation of latex flow referred to above. It is apparently a positive secretion and not the result of tissue disorganization. The latex itself is usually coagulated in the affected vessels, and the death of the vessel protoplast may

cause the formation of an enclosing cambium and a woody burr in the bark. A striking similarity was observed between brown bast and the local discoloration occurring at the margin of ordinary wounds in *Hevea*. They are closely related phenomena, and the former appears to represent merely an accentuated type of wound gum secretion. The chief factor in the causation of the disease seems to be repeated withdrawal of the latex from the same tissues. The disturbance thus set up causes a reaction of the drained tissues by the secretion of gum which prevents further loss of latex. There is a considerable depletion of starch in the diseased cortex, but not complete exhaustion.

Experiments undertaken with a view to determining the relation between severe tapping and brown bast showed that a distinct connexion existed. Three groups of fifty trees each, growing under similar conditions, were selected for comparative trials. Group A was tapped six times per diem, beginning at 6 a.m. and using two cuts on one-third of the circumference at a height of one-half and one metre. In less than a fortnight 40 per cent. of the trees showed typical symptoms of brown bast; after one month there were 58 per cent., and after two months 60 per cent. The trees of Group B were tapped once a day at 6.30 a.m., also with two cuts. After one month 2 per cent. of the trees were diseased, after six weeks 4 per cent., and after two months 10 per cent. Group C, which was only tapped for one month six times per diem, and with one cut on one quarter of the circumference at a height of half a metre, developed 2 per cent. of brown bast. In another series daily tapping on an isolated area of the bark caused a high percentage of brown bast. Further experiments to test the effect of disinfecting the cut showed that when the tapping was sufficiently severe, disinfection did not prevent a very high percentage of brown bast developing. Both tapping experiments and histological examination suggest that the response of the tissues is the result of an irritation or stimulation connected with the loss of latex, rather than of actual depletion or exhaustion of the reserve food, though there may be a temporary depletion of some constituents of the latex, e.g. the proteids.

Generally speaking, it appears that the same conditions which promote rapidity of growth and vigour of the tree also increase the tendency to brown bast. Trees growing on poor soil or exposed dry ridges are believed to be less liable to the disease than those in the adjacent rich and well-drained flats. In one case where *Hevea* was planted at an altitude of 2,200 to 2,800 ft., there was a progressive decrease in the amount of disease from 2,300 ft. upwards, probably because of the unfavourable conditions for growth.

Figures are also available showing that the disease develops more abundantly during the rainy season, which is also the time of the highest yield.

The length of the tapping cut does not appear to exercise any definite influence on the incidence of the disease, nor could any correlation be discovered between the size of the tree and its degree of liability to attack. No favourable influence from thinning on the development of brown bast could be detected. On the other

hand, in so far as thinning contributes to greater vigour and a higher latex yield, it may actually increase the proportion of the disease. Close planting and later removal of the most susceptible trees should help, however, to reduce the number of subsequent cases.

As regards preventive measures, a moderate system of tapping on alternate days on a single cut over half the circumference is advocated.

Extensive comparative experiments have now been started to ascertain which system will give the highest latex yield with a minimum of brown bast. In the meantime the alternate-day system has been favourably reported upon by several estate-owners, and should be generally used.

For new plantings the vegetative offspring of high-yielding trees which are also resistant to brown bast should be used. The selection of resistant individuals for propagation necessitates a test, which consists of tapping the proposed mother-trees five or six times per diem for two months, with two cuts on one-third of the circumference. This severe tapping will soon produce disease in the susceptible trees, and the remainder will serve as a source for vegetative planting.

Diseased trees must be treated if the same surface is to be tapped again within several years. Cures have been effected by each of the three common methods, i.e. scraping, stripping, and light scraping followed by the application of hot tar, but it has not yet been determined which of these methods is the best. For protection of the exposed tissues after scraping or stripping, the A.V.R.O.S. Experiment Station recommends coating with ordinary paraffin, but the writer found the following mixture gave the best results at Buitenzorg: Lamp wax (melting-point $40^{\circ}\text{C}.$), 50 per cent.; vaseline (dark commercial, melting-point $38^{\circ}\text{C}.$), 25 per cent.; soft paraffin (melting-point $55^{\circ}\text{C}.$), 25 per cent.; solidifying point of the mixture, 43 to $44^{\circ}\text{C}.$ The mixture can be applied with a wide thin-hair brush at a temperature of 50 to $70^{\circ}\text{C}.$, or warmer with a garden sprayer. For lower elevations the proportion of paraffin should be increased by 10 per cent. at least. The application of hot tar (Harmsen's method) is said to effect a throwing off of the diseased tissues, through stimulation of cambial activity. In this method the bark is simply scraped away superficially and warm tar painted on. Further experiments are necessary to test it fully, the results hitherto having varied so much as to be inconclusive.

RANDS (R. D.). **Histological studies on the Brown Bast disease of Plantation Rubber.**—*Meded. Inst. voor Plantenziekten*, 49, 27 pp., 9 pl., 1921.

Studies conducted by the writer during the last two years indicate that this is a non-parasitic trouble caused by certain methods of tapping. This conclusion is based on the results of work already published [see last abstract].

A striking feature which is constantly noted in sections of diseased bark is the yellow, plastic, gum-like secretion present in the latex vessels, and also filling and enlarging many of the intercellular spaces of the soft cortical tissues. The discoloration of the

tapping cut caused by this substance, in combination with the absence of latex, offers the best and most certain means of identifying the disease. The quantity and the extent of the gumming vary greatly with the individuality of the tree and are also dependent on environmental conditions, which, indirectly, affect the vigour and the physiological processes of the tree. Gum secretion is at its maximum during the rainy season in the most vigorous trees, the diseased bark colouring an intense brown, and showing a marked tendency to develop burrs. New cases are less frequent during dry weather or on defoliated trees, and the gumming, which in these cases is mostly confined to the latex vessels, may not be sufficiently abundant to cause appreciable browning of the cut even after latex flow has ceased, but the subsequent developments of the disorder may be equally serious.

The stoppage of the latex flow is due in the first place to the gumming of the latex vessels for some distance below the cut. An additional contributory factor is the coagulation of the latex itself, which in normal bark only occurs in old vessels of the outer layers that are much interrupted by stone tissue. Whether this coagulation precedes, occurs simultaneously with, or follows the gum secretion is difficult to determine, but in certain cases where the gum has been observed to flow into the latex, frequently surrounding the nuclei and sometimes even forming a crude reticulum, gumming appears to occur first. Lack of turgor in the diseased bark does not explain the stoppage of the latex flow, as some rows or parts of rows of normally acting vessels continue to flow for a considerable time after the remainder have ceased to function.

The gum-like substance in brown bast, which is first evident in the form of clear yellow microscopic droplets on the inner walls of the latex vessels and soon invades the latex, where it forms irregular masses, is secreted into the latex vessels from most of the adjoining parenchymatous cells. Simultaneously or at a later stage intercellular spaces filled with gum develop in the inner bark, usually in the parenchyma next the latex rows. When gumming is severe the resulting disturbance causes the death of the protoplast of the latex vessels, and humification changes are probably responsible for the dark cells in the centre of burrs, already referred to by earlier workers. The necrotic latex vessels contained in these burrs probably form the original stimulus which induces a cambium to develop in the adjacent cells and leads to the development of the burr. Burrs do not, however, necessarily occur under plantation conditions; in a specific case, only 14 per cent. of the diseased trees left untreated were found to show them. The majority of the burrs appear to take their rise from near the cambium, where the greater activity of the tissues favours their growth. If allowed to remain, they quickly connect up with the central woody cylinder of the tree; hence their practical importance in spoiling the bark for tapping.

The author has found that ordinary wounds reaching the inner bark give rise to changes which are surprisingly similar to the symptoms of brown bast, not only in the resulting discoloration, but even, in one case, in causing burr formation to commence. Microscopic examination shows the typical yellowish intercellular

secretion, which occasionally is also found in the latex vessels. Even the margins of tapping cuts on thoroughly healthy trees are sometimes similarly affected. Evidently in these cases there is a wound response, characterized by the secretion of wound gum of the type known to occur in a very wide range of plants. In *Hevea* a temporary covering is first formed by the coagulation of the exuded latex, followed rapidly by the closing of the wound through the formation of wound gum. A week or so later a cork layer is generally found to have developed just behind the gummed surface region, and is followed by stone tissue formation; the gummed layer is finally shed as a result of further bark growth. In the case of tapping cuts the formation of cork and stone tissues is prevented by frequent reopening, and here it is generally the coagulated latex which forms the protective covering. The conditions responsible for this wound reaction on the tapping cut are usually temporary, and the locally discoloured area disappears gradually after a week or more of continuous tapping; should, however, the discoloration persist and the areas showing absence of latex flow enlarge, without apparent cause, a case of brown bast may be suspected and the extent of the discoloration below the cut should be determined. Wood wounds show the same reactions and the locally engendered gum secretion agrees in every respect with that produced in bark wounds and in brown bast. The gum produced was examined in considerable detail, and was found to agree in its characters fairly closely with the wound gum already described in other plants.

The general conclusion arrived at by the author is that the disease known as brown bast is very probably only an abnormal and extreme type of wound response, and that this abnormality occurs apparently because of the nature of the wounding to which *Hevea* is subjected in the process of tapping. As a tentative explanation of the facts the author suggests that the repeated opening of the same wound in susceptible trees, and the frequent losses of latex from the same tissues over a considerable area below the cut, stimulate gum secretion not only in the tissues immediately surrounding the wound, as is normal, but also in cells situated at a distance, though the stimulus would, of course, act more feebly as the distance increased. This is confirmed by the observation that the secretion, which appears first at the wound, spreads very rapidly downwards and affects a fairly large area below the cut. The possible rôle of enzymes in this spread has not been determined.

SANDERSON (A. R.) & SUTCLIFFE (H.). **Brown Bast. An Investigation into its causes and methods of treatment.**—71 pp., 4 diag., 26 pl., London, The Rubber Growers' Assoc., 1921.

The book gives a full description of the characters of the bark in *Hevea* when affected with the brown bast disease.

The authors consider that the most characteristic feature of the cortex in cases of brown bast is the presence of meristematic tissue almost invariably in the vicinity of latex vessels, the latex in the vessels enclosed in the meristem being usually coagulated. The remaining characteristics of affected cortex, the deposition of tannins

and calcium oxalate, the excessive formation of sclereids (stone cells), often very deep seated, the depletion of starch, &c., they consider to be secondary symptoms, though these give rise to the diagnostic features of the disease.

In a large number of cases the beginning of meristematic activity can be definitely traced to a point or points immediately below the cut. In its earliest appearance it precedes the coagulation of the latex in the vessels bounded by the meristem, and it may be that this coagulation is due to by-products of metabolism from the active meristem, and is also assisted by the withdrawal of water from the latex by the new tissues formed. The formation of new tissues results in the displacement or even rupture of latex vessels in the neighbourhood. Burrs may then result from the development of a new secondary cambium arising in the place of the original simple meristem and cutting off woody cells on its inside. Functional sieve-tubes are present in normal bark within the limits in which the new meristem may develop, and in such cases they share in the displacement, &c., of the latex vessels. The meristem does not usually arise quite near the cambium, its depth being related to the depth of tapping. Spread towards the cambium takes place later on. Outward spread also occurs in some cases. Extension downwards below the cut (the authors believe the disease almost invariably begins immediately below the tapping cut) is in the form of a cone, the outer side of which early becomes flattened as the margin of the laticiferous tissue is reached, while the inner side may reach to the newest-formed latex vessels. The outer side may become flattened before it reaches the outer functional vessels, which may then continue to yield. In shallow tapping the inner vessels may also escape, at least for a time.

The authors believe that the disease may be caused in either of two ways. It may be the result of the stimulus arising from the presence of a wound meristem below the tapping cut (especially a finished cut). Such a meristem may set up secondary effects due to coagulation of the latex which it induces in its neighbourhood. These secondary effects spread the disease both laterally and in depth. The origin of the stimulus in the second case is different, though its effects are similar. When a strip of cortex is removed in the operation of tapping, a cork cambium forms in the shallow layer left overlying the cambium, and the exposed surface (the tapped surface) then proceeds to renew the bark under the protection of this cork. The stimulus caused by the abnormal activity of growth under this layer is believed to extend downwards into the still untapped bark below the tapping cut, and may be the cause of the induced meristematic activity mentioned in the last paragraph. In either case variations in the incidence of the disease may thus be due merely to variation in the sensitiveness of the response to the stimulus provided by tapping.

Thus brown bast is considered to be a physiological disorder due primarily to the operation of tapping, though other wounds may have a similar result. No case has been seen on an unwounded tree. The disease is distributed over the whole rubber-producing areas of the East, and it is probable that it is present on every estate on which trees have been in tapping for six months or more.

Well-grown or well-developed trees are more liable to it than slow-growing, poorly developed, thin-barked ones. The percentage of cases usually increases with the age of the trees, so long as tapping continues. In many instances it bears some relation to the interval between successive tapplings, so that the more frequent the tapping, the greater is the liability to develop brown bast. But further investigation on this point is necessary, and also more information as to the length of time between the formation of meristem and the cessation of the flow of latex.

Preventive measures for brown bast cannot be laid down, but, according to the authors' observations, areas under alternate-day tapping usually show a smaller percentage of cases than areas under daily tapping, other conditions being equal. Resting of the trees affected is not recommended, as many cases have been seen where the trees had been rested for periods of from two to six years, but still suffered from the disease.

After reviewing the treatment already existing, the authors recommend stripping off the diseased cortex as the only effective means for curing trees affected with brown bast, and they give a detailed description of the operation. It should be followed by an application of paraffin wax to the stripped surface, in order to protect it against the attacks of insects and fungi. Special emphasis is laid on the necessity of treating the trees at an early period of the disease if large areas of bark and cortex are to be prevented from becoming useless for tapping. The authors quote the experience on a number of estates where this treatment has been systematically carried out with excellent results, and they express the hope that the time is rapidly approaching when brown bast treatment will become part of the ordinary routine work of a rubber estate.

The practical part of the book is particularly full, and the illustrations comprise numerous photomicrographs (some coloured) of the affected cortex and photographs of affected trees and trees treated by stripping. There is an appendix on 'dry' trees, in which other forms of stoppage of latex flow are distinguished from brown bast.

HORNE (A. S.). **Phloem necrosis (Brown Bast disease) in *Hevea brasiliensis*.**—*Ann. of Botany*, xxxv, 139, pp. 457–459, 1921.

The evidence collected so far by other workers points to a physiological cause of this disease, which is analogous to the cases of phloem necrosis described for the potato by Quanjér and for Liberian coffee by Stabel. The special anatomical features described by Sanderson and Sutcliffe [see last abstract] would appear to be a secondary development.

On transverse sections of the bark taken both from diseased and suspected trees, numerous minute golden-yellow spots of irregular outline were observed in the phloem, in the region extending from the neighbourhood of the cambium outwards. The outlines of the coloured granular areas were at times similar to those of intercellular spaces, but differed from these by being intersected by one or more waved partitions, staining more or less distinctly with ruthenium red. These golden areas proved to be sections of necrotic

sieve-tubes which no longer showed a reaction for callus with soluble blue, while the waved outlines in many cases could be interpreted as transverse sections of the large vertical sieve-plates which form the dominant feature of the phloem of *Hevea* when viewed in longitudinal section. These pathological characteristics were found in material obtained both from Borneo and the Federated Malay States.

In the younger phloem the disease is confined to the sieve-tubes, but in the middle phloem region the discoloured areas are larger, as other cells—phloem parenchyma, medullary ray cells, laticiferous vessels—have become involved in the local tissue degeneration.

During the incipient stages of burr formation the wound cambiums arise in proximity to the diseased laticiferous vessels and often completely encircle small groups of vessels. As a result of the activities of the wound cambium, diseased groups of cells, including laticiferous vessels, become enclosed in a 'pocket' of stone cells. The number of meristematic zones will depend on the number of rows of laticiferous vessels affected and their disposition in the bark.

BRYCE (G.). **Brown Bast and the Rubber plant.**—*Nature*, cviii, pp. 81–82, 1921.

The statement made by the writer of a note in a previous issue of *Nature* on phloem necrosis in brown bast disease of *Hevea* [see last abstract] that the diseased laticiferous tissue is enclosed in 'stone-cell pockets' is controverted. Occasionally stone-cell groups, which are abundant in normal cortex, are fortuitously enclosed in the nodule cambium at the time of its inception, but the cortex overlying old nodules, and presumably derived from the nodule cambium, is strikingly free from stone cells.

KIRCHNER (O. v.). **Über die Bekämpfung von Pflanzenkrankheiten, im besonderen von Getreiderost und Getreidebrand, durch züchterische Massnahmen.** [The control of plant diseases, especially rust and smut of Cereals, by means of breeding.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 6, p. 55, 1921.

The following is a résumé of a lecture given by Prof. von Kirchner at the autumn meeting of the German Agricultural Society (Seed Selection Division). The foundation of all selection with a view to immunization is the determination of the degree of resistance possessed by the wild and cultivated varieties of economic plants to parasitic attack. The investigations into rust of wheat, carried out by von Tubeuf, Hecke, and the speaker, extended over a period of ten years. With regard to susceptibility to bunt, experiments were started at Hohenheim in 1903 on 360 varieties (241 winter and 119 summer wheats), of which two summer spelt, one English wheat, and summer einkorn proved absolutely immune. Four summer wheats, with most of the hard varieties and Polish wheats, were very resistant. Recent investigations by Prof. Roemer of Halle have shown that there are also great differences as regards resistance to loose smut in the various sorts of wheat.

Absolute immunity to rust has not yet been secured. The degree

of severity of the attack on the different sorts varies according to external conditions, but the mode in which they are attacked is characteristic of the variety. Besides einkorn, certain English varieties are resistant to both brown and yellow rust, while four are also able to withstand black rust, viz. Beardless Odessa, Ohio, the smooth, red, black-edged hard wheat, and the blue-black hard wheat. The degree of resistance to smut and rust is inherent in the variety. The quality is transmitted to descendants, but is capable of modification through external influences. In 1916 the speaker detected a striking correlation between the acid content of the different varieties and their resistance to smut and rust. He compared two winter and summer wheats, one of each being resistant to yellow rust and the other susceptible. In both cases the acid content was higher and the sugar content lower in the resistant variety. It is probable, however, that the real origin of immunity lies still deeper, and is related to the cytoplasmic constitution of the cell.

The practical significance of the foregoing observations as a basis for the selection and breeding of new varieties is briefly referred to, especially in view of the fact that rust-resistance in wheat is inherited in accordance with Mendel's laws, as was first demonstrated by Biffen in 1907 and 1912. Nilsson-Ehle and von Tschermak, however, have come to the conclusion that in this particular instance the conditions of inheritance are less simple than as stated by Biffen. The selection of smut-resistant varieties has not hitherto been considered as of such urgency, owing to the adequate protection afforded by seed-disinfection.

It is essential that this line of investigation, the object of which is to reduce or, if possible, entirely avoid the extravagant preventive and curative measures at present necessary, should be extended to other important economic crops.

POPP (M.). **Die Steigerung der Ernteerträge durch geeignete Boden-Desinfektion.** [The increased yield of crops obtained by suitable disinfection of the soil.]—*Landwirtschaftl. Jahrb.*, lv, 4-5, pp. 549-579, 1921.

The writer advocates the use of humus-carbolineum (the preparation of which is described) not only as a fertilizer, which acts by stimulating the beneficial soil organisms, but also as an excellent means of plant protection against insects and fungi. It is said to be particularly useful for spraying and painting fruit-trees, obstinate cases of canker having been completely cured by its application. Experiments have also shown that club-root of cabbage (*Plasmodiophora brassicae*) can be checked by strewing humus-carbolineum into the holes, when transplanting, at the rate of 10 to 15 gm. per plant. It should only be applied when the ground is moist, so that it may dissolve more easily.

SHUNK (I. V.) & WOLF (F. A.). **Further studies on bacterial blight of Soybean.**—*Phytopath.*, xi, 1, pp. 18-24, 1921.

This disease has been described from Wisconsin (*Journ. Agric. Res.*, xviii, 4, 1919) and from North Carolina (*Phytopath.*, x, 3, 1920). Either one of two species of bacteria may cause it, namely,

Bact. glycineum and *Bact. sojae*. Their differences in cultural characters are described.

KENDRICK (J. B.) & GARDNER (M. W.). **Seed transmission of Soybean bacterial blight.**—*Phytopath.*, xi, 8, pp. 340-342, 1 pl., 1921.

Seeds were removed from pods of soy-bean which bore bacterial lesions. Some of the seeds themselves showed lesions. Tests in sterilized soil in the greenhouse were made by planting these seeds and seeds from healthy pods. Sixteen out of 139 plants produced from seed borne under pod lesions developed bacterial blight, as did also four out of forty-seven plants from seed from diseased pods, but not from directly under the lesions. None of 124 control plants from seeds from healthy pods showed the disease. It appeared that infection may be carried externally or internally with the seed.

The organism was identified as *Bacterium sojae* Wolf.

DIEMER (M. E.) & GERRY (ELOISE). **Stain for the mycelium of molds and other fungi.**—*Science*, N.S. liv, pp. 629-630, 1921.

In order to differentiate mycelium in wood, 'a solution of silver nitrate in distilled water was applied to thin sections of the infected wood. These were allowed to stand for periods of various lengths, overnight staining giving a very satisfactory result. The sections were then examined directly or dehydrated with alcohol, cleared with xylol, and, mounted in Canada balsam. Drying the balsam mounts under weights in an oven overnight appeared, if anything, to improve the stain secured.'

This was found satisfactory for conifers or hard woods. The mycelium stains blackish brown, purplish brown, or orange, and the wood was either not stained or only yellowish brown.

Gold chloride solution and 'Berlin blue' were also used with some success.

ROSEN (H. R.). **Unlike interpretations of Fuller's scale in determining degree of acidity.**—*Science*, N.S. lv, pp. 76-77, 1922.

The author points out that plant pathologists usually express acidity or alkalinity in terms of parts per thousand of normal alkali or acid required to neutralize. This is in accordance with Fuller's original description and E. F. Smith's report of Fuller's method in 'Bacteria in relation to Plant Diseases'. Bacteriologists and animal pathologists, on the other hand, have been following a 'Report of a committee of bacteriologists of the American public health association' which recommended the use of parts per hundred. Thus '+ 10.0 on Fuller's scale' as used by plant pathologists corresponds to '+ 1.0 on Fuller's scale' as used by bacteriologists in general.

STAGG (C. M.). **A new seedling disease of Tobacco.**—Abs. in *Phytopath.*, xi, 1, p. 49, 1921.

A fungus closely resembling *Fusarium affine* Faut. & Lamb. was found causing a leaf spot and stem browning of tobacco in

Kentucky in 1918. It was isolated, and reproduced the disease when used for inoculation. In very humid air it causes a type of damping off, while in dryer conditions only a slight browning or girdling of the stem results. The conidia are hyaline, one-septate, straight or slightly curved, tapering slightly at the top and 12 by 3 μ in diameter. They are borne singly at the tip of digitoid conidiophores arising usually at right angles to the septate mycelium.

BIRMINGHAM (W. A.). **A treatment for Tomato wilt on trial.**—*Agric. Gaz. of New South Wales*, xxxii, 3, p. 212, 1921.

The treatment under test consisted of watering the soil with a solution of ammonia (strong ammonia one tablespoonful, water one and a half gallons) five times a week, and of spraying the plants with a solution of saltpetre six days a week. It had been claimed that successful results had been obtained from this treatment.

The result has been disappointing in every respect. The plants not only showed no appreciable improvement after two weeks, when compared with untreated controls, but the cost of material and labour involved place the treatment out of court for large and small plantations alike.

PETRAK (F.). **Mykologische Notizen, ii. 31. Über die Schwarzfäule der Tomaten.** [Mycological Notes, ii. 31. On the black rot of Tomatoes.]—*Ann. Mycol.*, xix, 1-2, pp. 17-20, 1921.

The fungus which causes this well-known disease makes its first sporadic appearance on the leaves in the early summer, but it spreads considerably later in the season, and finally attacks the stems and fruits, the latter taking on a black colour and rotting. The author's attempts to obtain a fruiting specimen of the fungus long remained unsuccessful, all spots examined proving sterile until in the summer of 1920 well-developed examples were found.

The subepidermal, lentiform pycnidia, generally 100 to 150 μ in diameter, are distributed somewhat loosely at regular intervals, a closer grouping of two or three occurring seldom; they are attached to the epidermis at their apex, and only emerge at the small, obtusely conical, papillary ostiole, which is perforated by an almost circular pore, 15 to 20 μ in diameter. The wall is of a transparent brown colour, thin, and usually consists of only one layer of irregular polyhedral, often slightly stretched cells, measuring 5 to 11 μ . The hyaline spores, 7 to 11 by 2.5 to 3.5 μ , are cylindrical or elongated, broadly rounded off at both ends, straight or slightly bent, containing finely granular plasma and some very small oil drops, at first single-celled, later divided by a partition about midway between the ends, this point being only slightly, or not at all, constricted. No sporophores have been observed.

The fungus rarely matures on the fruit, as the hyphae which permeate the tissues are generally destroyed by yeasts and bacteria before the fruiting stage is reached. The last-named agents are themselves also able to produce a black rot of the ripe fruit, although in this case the affected parts are very soft and generally of a much lighter colour.

According to the author's experience the fruit is most frequently attacked at the stem end when it has been picked green and spread

to ripen in such a way that the stem end is placed downwards. Under such conditions the fungus develops luxuriantly, and forms fruit bodies in every way identical with those observed on the stems, except perhaps that the wall in the later stages is stronger, blackish-brown, and almost carbonaceous. The spores are mostly elongated, oval, or almost globular, 5 to 8 by 1.5 to 3 μ or 3.5 to 4 μ ; only occasionally were these spores found with a partition, and in such cases their measurements were up to 10 by 3 to 3.5 μ .

Of several varieties tested, 'Johannesfeuer' proved the most resistant to the disease, the fruits remaining on the plant being very lightly affected by the fungus. The author makes the following recommendations for the preservation of fruit picked early and spread for ripening: Care should be taken to pick the fruit with a short piece of the stalk; they must then be kept absolutely dry, and this can be done quite easily and cheaply by placing them on boards covered with a thin layer of straw, with the stalk pointing upwards; they should be evenly spaced and not touch; they must be guarded against damp—rain, dew, &c.—and all affected fruit should be carefully removed.

The author has come to the conclusion that the fungi described as *Phoma destructiva* Plowr., *Ascochyta lycopersici* Brun., and *Ascochyta socia* Pass. are in reality different phases of the same fungus, which he names *Diplodina destructiva* (Plowr.) Petr., the wall of the typical pycnidium having a parenchymatous structure. *Sphaeronema lycopersici* Plowr. is perhaps also only a form of this fungus. [See also Klebahn, this *Review*, i, 2, p. 47, and the following abstract.]

BROOKS (F. T.) & SEARLE (G. O.). **An investigation of some Tomato diseases.**—*Trans. Brit. Myc. Soc.*, vii, 3, pp. 173-197, 1921.

A detailed account is given of investigations into various rots of tomato fruits and certain diseases of the stems of tomato plants. The research material collected in the course of several years yielded pycnidial fungi of the *Phoma* and *Diplodina* types, together with *Colletotrichum* or *Gloeosporium* and a species of *Fusarium*. The identity of the different rot-producing fungi occurring on the tomato fruit was evidently, from a review of the literature and the examination of herbarium specimens, far from being clearly established, and a detailed study of the cultural characters and pathogenicity of the various forms isolated by the authors was undertaken in order to determine their relationships with one another and with previously described forms. After a description of the origin of the cultures and their pathogenic properties, their macro- and microscopic characters are described at length and compared with cultures and herbarium specimens of some of the earlier species.

The conclusion is reached that the species identified in the United States as *Phoma destructiva* Plowright is the same as one of the pycnidial forms isolated by the authors, though they only obtained it from fruits, while in America it attacks also the leaves and stem. On the other hand, the British fungus responsible for tomato stem 'canker' and fruit rot, which has up to the present been identified with the United States *Mycosphaerella citrullina* (C. O. Sm.) Gross.,

proved on comparison with authentic material of the American fungus to be quite dissimilar. It is intermediate in type between *Phoma* and *Diplodina*, and agrees with Cooke's *Phoma lycopersici*, but must be regarded as a *Diplodina* and probably identical with the *Diplodina lycopersici* of Hollós. An amended description of *Diplodina lycopersici* (Cke.) Hollós is given. *Ascochyta lycopersici* Brun. may be the same as this fungus, as also may be Plowright's *Sphaeronema lycopersici*, the type of which appears to be lost. *Myosphaerella citrullina* has so far not been found in England, and should therefore be deleted from the list of British species. Klebahn, in his recent paper on the tomato canker fungus in Germany [see this *Review*, i, 2, p. 47], also refers it to *Diplodina lycopersici* Hollós, and describes the discovery of the perithecial stage, *Didymella lycopersici*. It is evident from the authors' studies that the limits of the genera *Phoma*, *Diplodina*, and *Ascochyta* are ill defined, and that many so-called species in these genera are merely varieties of one and the same fungus.

Another pyrenidial fungus, found only once as the cause of tomato rot, has an *Alternaria* stage in its life-history like *Phoma richardiae* and *P. ficiilis*. It proved to be an undescribed species to which the name *Phoma alternariaceum* Brooks & Searle is given. Forms of *Macrosporium* were frequently met with, but they proved to be non-pathogenic. *M. tomato* Cke. was not found, though the disease said to be caused by this species was described by Massee in England some years ago. It is thought likely that Massee's account of the disease was based on a mixture of forms. In America *M. tomato* has been shown to be the cause of a disease of uninjured tomato fruits.

Several strains of *Gloeosporium* and *Colletotrichum* were found to be parasitic on tomatoes, one of them being identical in every respect with cultures of *C. phomoides* (Sacc.) Chester from America, except that it did not always produce setae on artificial media. The other strains are also regarded as being merely varieties of the same species, differing chiefly in being of the *Gloeosporium* type, i. e. without setae. This is the first time that this fungus has been recorded in England.

A typical species of *Fusarium* was also isolated from rotten fruits, and proved a wound parasite of the green fruit, as in the case of the other fungi mentioned above. In the absence of comparative cultures it was impossible to identify it. It is thought probable, however, that quite a number of species belonging to this genus would rot tomato fruits if inserted in them through wounds, and in fact a pure culture of *Fusarium coeruleum*, obtained from potatoes, produced a soft rot.

A postscript refers briefly to Petrak's recent paper on black rot in tomatoes [see last abstract]. The authors do not consider Petrak justified in renaming Plowright's *Phoma destructiva* as *Diplodina*, though they admit that it is doubtful whether a sharp line can be drawn between the *Phoma* and the *Diplodina* studied by them. Still, the constancy of the spore characters in certain forms both in England and America, and the absence of inoculation and cultural experiments in Petrak's work, make the retention of both the names given in this paper seem desirable.

HUBERT (E. E.). **Notes on Sap Stain Fungi.**—*Phytopath.* xi, 5, pp. 214–224, 1 pl., 4 figs., 1921.

A staining of the sap-wood in timbers, caused by *Lasiosphaeria pezizula* (B. & C.) Sacc. and *Ceratostomella* spp., is described. The former produces a greyish-olive stain which may be found both in sap-wood and heart-wood, and the latter produces a greyish-blue stain confined principally to the sap-wood. Perithecia of *L. pezizula* were found on the surface of the wood. The effect of the fungi on the tissues is described. The hyphae penetrate the walls of the wood fibres and tracheids. The *Ceratostomella* hyphae are capable of reviving after lying dormant in the wood for a considerable period.

A slight weakening of the wood was found to occur in the case of the blue stain caused by *Ceratostomella* spp. The stain further serves to hide the effect produced by wood-destroying fungi which often develop simultaneously. Blue-stained wood also seems to be unsuited for steam bending in the process of making furniture and other products.

PETRAK (F.). **Mykologische Notizen**, ii, 51. *Diaporthe thujae* n. sp. [*Mycological Notes*, ii, 51. *Diaporthe thujae* n. sp.]—*Ann. Mycol.*, xix, 1–2, p. 50, 1921.

The author describes *Diaporthe thujae* n. sp., found at Mähr.-Weisskirchen on a dry twig of *Thuja*. The fungus is extraordinarily like a *Valsa* of the *ambiens* type, and is almost certain to be the ascigerous form of *Phomopsis thujae* Died., in close proximity to which it was discovered. It differs from *D. pitya* Sacc. in the euvalsoid stromata, stronger perithecial membranes, and stouter ostioles. In view of the inadequate descriptions of other species in the literature, the author prefers to regard *D. thujae* as new, although the possibility exists that it may be identical with one or other of the forms already described on conifers.

BURKHOLDER (W. H.). **The bacterial blight of the Bean, a systemic disease.**—*Phytopath.*, xi, 2, pp. 61–69, 1921.

Bacterium phaseoli E. F. Sm. was found to be viable in bean seeds two years old, and in several cases seeds three years old produced blighted plants. Besides the common symptoms on pods, seeds, leaves, and stems, the writer found that the growing tips of young seedlings might be destroyed by the bacteria, leaving only the cotyledons, or the primary leaves might show mosaic-like lesions, or a wilting might be caused. The bacteria have been found to multiply in the vascular tissue, gaining entrance to this tissue from cotyledons, and perhaps from the primary leaves. They may break through the xylem vessels and cause lesions on the leaves or stems similar to those caused by local infection. The roots are also often infected in the xylem vessels. The organism may enter the pods and infect the seeds without causing lesions on the surface of the pods. Inoculation experiments demonstrated that the bacteria may travel through the vascular tissue.

Local infection of plants may be subsequently caused by spread of the organism by rain or insects.

It is thought that *Bacterium phaseoli* probably loses its virulence rapidly in culture.

GILMAN (J. C.) & ERWIN (A. T.). **Greenhouse propagation of Cabbage resistant to yellows.**—Abs. in *Phytopath.*, xi, 1, p. 54, 1921.

The seed was planted in flats of soil infested with *Fusarium conglutinans*, and subjected to the optimum temperature for the development of the disease. The selections were made a month later, the healthy plants being transferred to pots and later to beds in the greenhouse, and allowed to produce seed. Strains of early cabbage were thus obtained which were completely resistant to yellows.

JENNISON (H. M.). **Observations upon the bacterial blight of field and garden Peas in Montana.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

Pseudomonas pisi Sack. (Ps. 211. 2322033) is serious in parts of Montana, having caused an estimated loss of 25 per cent. in 1918. It is thought to be disseminated by contaminated seed. The variety Alaska is one of the most susceptible.

PETRAK (F.). **Mykologische Notizen, ii, 32. Über Ascochyta Boltshauseri Sacc.** [Mycological Notes, ii, 32. Notes on *Ascochyta boltshauseri* Sacc.]—*Ann. Mycol.*, xix, 1-2, pp. 20-21, 1921.

The author has noticed great differences in resistance to *Ascochyta Boltshauseri* Sacc. amongst the different varieties of cultivated beans in the Mähr.-Weiskirchen district. Thus *Phaseolus multiflorus* was almost immune, while 'Korbfüller-Wachs', a climbing variety of *P. vulgaris*, was only affected late in the season, when the plants had nearly finished bearing. Dwarf varieties of *P. vulgaris*, on the other hand, suffered somewhat severely, the fungus gaining a foothold during the flowering stage of the plant and damaging it by destroying its leaves. The most susceptible variety encountered by the author was the 'blauschotige Butter', and here the parasite started by forming larger or smaller, mostly very irregular spots on the leaves, which gradually spread to the whole surface and caused their death. The dead leaves dry up, but remain on the stalk, and in damp, cool weather the destruction of nearly all the leaves is a matter of only a few days, after which the stem is attacked, and this often brings about the death of the plant before the end of the flowering season.

Attempts to check the disease were not successful, and the only thing to do is to see that the leaves on which spots appear are instantly removed and burned. The disease, on its first appearance, occurs in a mild form, but on fields where it has firmly established itself it is advisable to sow climbing instead of dwarf beans, as the former are much less susceptible.

The fungus, which has characteristic large, broadly cylindrical spores with 1 to 3, more rarely 4 septa, is renamed *Stagonospora hortensis* (Sacc. & Malbr.) Petr., and stated to have as synonyms *Stagonospora hortensis* Sacc. & Malbr., *Ascochyta Boltshauseri* Sacc.,

and *Stagonosporopsis Boltshauseri* Died. The author does not think that von Höhnel was right in regarding this fungus as an imperfect stage of *Didymellina phaseolicola* (Rob.) v. Höhn., it being, in his opinion, more likely that *Ascochyta phaseolorum* Sacc. occupies that position. *Stagonosporopsis* includes fungi having pseudo-pycnidial receptacles and hyaline, cylindrical, or elongated to short and broadly spindle-shaped spores, with one to three or more septa.

HAMBLIN (C. O.). **Downy mildew of the Vine.**—*Agric. Gaz. of New South Wales*, xxxii, 1, pp. 49-50, 2 pl., 1921.

Downy mildew (*Plasmopara viticola*) appeared in New South Wales at Albury in January 1918, and in the same month its occurrence was noted at Glenfield, while a fair amount of damage was done by the disease during the summer of 1919 round about the county of Cumberland. It was observed as early as 6th October 1920 at Richmond, but the dry weather checked its progress. On the other hand, reports from the Murrumbidgee Irrigation Area speak of very serious damage having been caused by the fungus, specimens of which were collected in that district early in November.

Bordeaux mixture at summer strength (6.4.40) has been found very effective. Where good lime is not obtainable Burgundy mixture should be substituted and used at summer strength. The commercial brands of Bordeaux paste and Bordeaux powder also gave effective control when tested in the preceding season. It should be noted that sprayings should take place at intervals of from ten to fourteen days, practically up to the time of ripening, to prevent the development of the fungus.

MANUEL (H. L.). **Downy mildew.**—*Agric. Gaz. of New South Wales*, xxxii, 10, pp. 745-747, 1921.

When the disease first appeared in the Rutherglen district of Victoria in 1917 growers were inclined to treat it lightly, but the following year only a 5 per cent. crop was picked from a district of 6,000 acres of vineyard. It has continued to spread from this first centre until practically every vine area in Victoria is now affected, and extension into New South Wales, Queensland, and South Australia has occurred.

Spraying as a regular preventive measure is recommended, as the disease has come to stay. Bordeaux or Burgundy mixture should be used, and, although no hard and fast rule can be laid down, it is advisable to make the first application when the shoots are about nine inches long, and to follow with others from time to time as new growth appears.

OSBORN (I. G. B.). **Downy mildew in S. Australia.**—*Journal Dept. Agric. South Australia*, xxiv, 12, p. 1007, 1921.

The author visited the Clare and Renmark areas, and found slight traces of the fungus on Currant, Gourds, Doradillo, and Sultana vines, both nursery stock and trellised vines. The mild attack in these areas is ascribed to the arrival of the fungus late in the season. Growers have been warned of the danger, as the

fungus has already proved to be destructive in Victoria and New South Wales.

MAZZACCARA (G.). **Il *Bacillus vitivorus* e il mal nero della Vite.** [*Bacillus vitivorus* and the 'mal nero' of the Vine.]—*Riv. di Agric.* (Parma), xxvi, 5, p. 6, 1921.

The 'mal nero' disease of the vine is found all over Italy, particularly in the southern provinces, and attacks both American and European varieties. The causal organism (*Bacillus vitivorus* Bacc.), the pathogenicity of which was first established by Baccarini, is an anaerobe, measuring 1 to 2 by 0.5 μ , that liquefies gelatine and has its optimum temperature at about 24° C. Entrance into the plant is gained through wounds caused by pruning, and vines grown in excessively fertile soft or volcanic soils are particularly liable to the disease.

Affected plants are recognized by brownish-black stripes which appear on the branches and become more pronounced as the disease progresses. The underlying tissues collapse and crack ('mal dello spacco'), the resulting lesions, which have blackened margins, reaching in some cases, especially in old branches and in the main stem, as far as the pith. The disease spreads from the apex to the base of the vine. In the vessels and other cells is found a gummy substance resulting from the activity of the bacillus on the tissues. In the spring the affected plants present a stunted appearance with shortened internodes and poorly developed foliage. The leaves may be blackened or covered with brown spots, and both the flowers and the fruit may be malformed and show teratological alterations. Numerous suckers arise around the base of the plant.

Generally speaking, affected plants die in about five years unless remedial measures are carried out in time. Preventive measures consist in clean cultivation, good drainage, and in grafting on resistant varieties, such as the 'Cataratto' and 'Minella' of Sicily. To check the disease, the blackened stems must be cut back to the base and destroyed, and all the lesions disinfected with a mixture of ferric sulphate and sulphuric acid. Young shoots affected by the disease should be removed in the spring.

MAURITIUS. **Annual Report of the Department of Agriculture for the year 1920. 1921.**

The Entomologist reports that cryptogamic diseases of sugar-cane were little in evidence, only a few sporadic cases of black smut being recorded. Rust disease, which was somewhat prevalent in previous years, was not reported to exist in a very severe degree in any estate. Several cases of bacterial diseases of the heart of the cane occurred in 1920 on two estates, but the attacks were, as in former years, limited to small areas.

The researches on the disease of *Filao* (*Casuarina equisetifolia*) were continued without bringing to light any specific micro-organism which could reproduce the disease experimentally. An experimental plot was selected at Grand River South East for trials relating to the transmission of the disease under natural conditions.

Report on the prevalence of some Pests and Diseases in the West Indies during 1919: Diseases of Economic Plants.—W. Ind. Bull., xix, 1, pp. 31–37, 1921.

Notes are given on the distribution and severity of the following diseases in the British West Indian Islands: CACAO: Root diseases (*Rosellinia* spp.), canker and black rot of pods (*Phytophthora faberi* Maubl.), brown rot of pods, die-back and stem disease (*Diplodia theobromae* Pat.). COTTON: Soft rot of bolls (*Phytophthora* sp.), stated to have caused considerable damage in St. Vincent, West Indian leaf mildew (*Ovulariopsis gossypii* Wakef.), bacterial boll disease (external), angular leaf spot, internal boll disease, rust (a physiological affection). LIMES AND OTHER CITRUS TREES: Black root disease (*Rosellinia* spp.), unidentified root or collar diseases, die-back, wilting and damping-off of seedlings. SUGAR-CANE: Root disease (*Marasmius sacchari* Wakker, and allied species), rind fungus (*Melanconium sacchari* Massee), red rot disease (*Colletotrichum falcatum* Went), pine-apple disease (*Thielaviopsis ethacetica*). ONIONS: Bacterial rot. FUNGI PARASITIC ON INSECTS: *Cephusporium lecanii*, shield scale fungus, red-headed and sooty mould fungus on scale insects. *Sporotrichum globuliferum* (thrips fungus) has not been seen during the year, though introduced in Grenada.

COTTON (A. D.). Fungi, Bacteria, etc., in Report on the occurrence of insect and fungus pests on plants in England and Wales for the year 1919.—Minis. of Agric. and Fish. Misc. Publ. No. 33, pp. 26–68, 1921.

This is the first attempt—official or otherwise—to give in a convenient form a complete list of the diseases of crops of any consequence in the country, over 250 being mentioned. The resulting waste of food-stuffs must reach an enormous total, and though it has up to now been difficult to secure exact figures except in a few cases, losses of 50 per cent. from wheat rust in many fields in South-west Wales, some of which were not worth threshing, 25 per cent. from barley smut in a case in Cambridgeshire and nearly 50 per cent. in one in Shropshire, up to 75 per cent. from potato leaf-curl in gardens and allotments and the same from dry rot in a case of Scotch seed sent to Kent, 20 per cent. from tomato stripe in cases in the London area and Northumberland, and some others of almost equal magnitude, are recorded.

The relation existing between the fluctuations of individual diseases and the climatic variations of particular seasons is receiving particular attention from the Plant Pests Branch of the Ministry. The charts appended to the Report, showing the variation from the normal in temperature, rainfall, and sunshine weekly throughout the year in the six main divisions of the country, will in time, it is hoped, enable a correlation to be established between climatic factors and the incidence of disease. Weather conditions during the crop year 1918–19 were marked chiefly by high rainfall in autumn, winter, and spring, followed by an unusually dry summer which was probably responsible for the mildness of the annual attack of potato blight (*Phytophthora infestans*). On the other hand, the fact that, in spite of a wet July in East Anglia, blight

was almost absent in that area suggests that there are other influences at work, the nature of which is still to be determined.

There is abundant evidence that the treatment of seed-grain against such diseases as wheat bunt, oat smut, and barley stripe disease has not yet become as routine a part of farm practice in England as in other countries, with the result that these diseases are far too prevalent. Black rust (*Puccinia graminis*) has been for many years remarkably scarce in England, but a severe outbreak was recorded during the year under review from South-west Wales. This was traced to the presence of barberry in the infected area. An attack of a *Fusarium* on wheat occurred on one of the experimental farms, but though *Giberella saubinetii* was suspected to be the cause, no perithecia were found. *Rhynchosporium graminicolum* Heins. was found on rye, this being the first British record.

Evidence was obtained that most new attacks of wart disease of potatoes were associated with the use of seed from infected districts. Seed is now regarded as the chief agent in disseminating the disease, and steps are being taken to gain a more complete control over the seed supply. Amongst the varieties immune to this disease (eighty-eight are approved by the Ministry), now so widely cultivated in the infected areas, several are reported to be also resistant to *Phytophthora* blight, though they were not severely tested during the year. Leaf-curl is increasingly recognized in England as a serious disease and appears to do more damage than mosaic, though the latter is abundant. Blackleg (*Bacillus atrosepticus* Van Hall) is believed to be on the increase. Skin spot (*Oospora pustulans* Owen & Wakef.) does little damage as a rule, but when severe on seed-tubers it can weaken or even destroy the eyes. The disease is doubtless contracted from the soil, but manifests itself after storage, particularly in spring. A cause of very heavy losses in the season 1918-19 was the faulty clamping of potatoes due to bad weather and shortage of labour, which, coupled with the inclusion of a number of infested and 'green' tubers, gave rise to exceptional heating, temperatures up to 160° F. being recorded in some cases. Where parasitic bacteria such as *B. atrosepticus* were present, the high temperature generated brought about very rapid decay, with disastrous results.

Amongst vegetable diseases, white rot in onions, a recently described disease in England, due to *Sclerotium cepivorum* Berk., was reported chiefly from the southern counties and Wales, but it occurred in a milder form in 1919 than in the preceding year. Two new cases of onion smut (*Urocystis cepulae* Frost) occurred in Westmorland and Huntingdonshire, the former being traced to seed imported from America. The disease also recurred in the three centres in which it was first found in England a few years ago. Investigations carried out in 1919 by Paine and Bewley established the fact that tomato stripe is due to a small yellow bacillus probably identical with *Bacillus lathyri* Manns & Taub., and not to *B. solanacearum* E. F. Smith as hitherto thought. Leaf spot in tomatoes (*Septoria lycopersici* Speg.) was introduced into this country from the United States in 1908 and included in the Destructive Insects and Pests Act in 1910, since when it appears to have died out.

Phytophthora fruit rot on apples (*Phytophthora cactorum* Schroet.) is a disease newly reported in Britain, a single case being found in Kent. The fungus may possibly be the cause of common and important rots occurring on fallen fruit. A few cases of the very rare leaf blister (*Taphrina bullata* Tul.) were observed on pears at Long Ashton and in the Evesham district. Plum-trees continue to be affected by silver leaf (*Stereum purpureum* Pers.), especially in the North, and whilst it is not possible to give exact data the number of fresh cases is believed to reach five figures. This disease is scheduled in the Destructive Insects and Pests Act. Following the remarkable scarcity of American mildew (*Sphaerotheca mors-uvae* Berk.) in gooseberries in 1917, possibly due to the cold winter, a recrudescence set in, and the disease had in 1919 regained its old ascendancy. Lime sulphur sprays are said to be effective in checking its spread.

Chestnut blotch of mushrooms, due to a bacterial parasite *Pseudomonas tolaasii* Paine, was reported for the first time in England in a severe form at Brentford (Middlesex), but later gradually disappeared.

A rot occurring on rhubarb plants, chiefly in Yorkshire, was found to be caused by a bacillus of the *B. coli* group. More sanitary methods of cultivation have been successful in checking the disease. *Keithia thujina* Dur., which is stated to have killed seedlings of *Thuja gigantea* in Ireland, appeared in England for the first time in 1919 near Horsham in Sussex, where it developed abundantly on the fading foliage.

VINCENS (F.). **Rapport sommaire sur les travaux effectués au Laboratoire de Phytopathologie de l'Institut Scientifique de l'Indochine du 1^{er} Janvier 1919 au 1^{er} Juillet 1921.** [Summary of the work carried out at the Phytopathological Laboratory of the Scientific Institute of Indo-China from January 1, 1919, to July 1, 1921.] 19 pp. Saigon, Imprimerie Commerciale, 1921.

RICE. *Sclerotium oryzae* Catt. is one of the most common fungous diseases of rice in Indo-China, and causes a great deal of damage. In one district it was evidently the cause of a form of 'tiêm'—the vernacular name for a number of different affections of the rice plant which are not distinguished by the cultivators—a disease not unlike the Italian 'brusone' which is believed by some phytopathologists to be caused by the same fungus. In India and Japan it also causes serious damage. *Piricularia oryzae* Br. & Cav., another fungus believed to cause 'brusone', was also observed on plants affected by 'tiêm', but as it was usually associated with species of *Helminthosporium*, *Cercospora*, *Cercosporella*, *Fusarium*, *Phoma*, *Sporotrichum*, *Septoria*, *Sphaerella*, &c., responsibility for the disease cannot be definitely attributed to it. *Helminthosporium*, *Cercospora*, *Phoma*, and *Sphaerella* develop on all the aerial organs, especially the peduncles of the ears, causing the abortion of a large number of flowers. They live on the grain from one year to the next, fructifying on the grain coats. *Fusarium* and *Sporotrichum* have been observed on partially aborted grain, on apparently healthy spikelets, and on young deformed and discoloured leaves,

and are associated with a rather serious disease which occurs fairly frequently in Cochin China. *Sporotrichum* is apparently the cause of the disease known by the natives as 'white ring', 'shrivelled tip', &c. *Ustilaginoidea virens* (Cke.) Tak. is a curious parasite of rice, the biology of which is little understood. The fungus develops at the expense of the grain, in place of which appears an orange or olive-green mass, separating the glumes and protruding between them. The disease receives little attention from the native rice-growers, who are even inclined to regard it as indicative of a good harvest. The writer, however, thinks that it is one of the (relatively uncommon) stages of a very widespread parasite, which in other stages frequently causes partial sterility of the spikelets, in which case it is of considerable importance. Experiments are in progress to verify and extend the results already obtained with regard to this disease. *Tilletia horrida* Tak. has been recorded from Tonkin, but the damage caused by it is negligible.

RUBBER. Leaf diseases cause relatively little permanent damage. *Gloeosporium*, *Colletotrichum*, and *Phyllosticta* are of frequent occurrence, but do not directly imperil the existence of the trees. The lesions which they produce on the young twigs, however, are very apt to serve as a starting-point to more serious troubles, which spread to the larger branches and may cause serious injury. In November 1919 a parasite allied to that which produces the black rot of the vine was observed on the leaves in a rubber plantation. Comparative analyses of the soils of the diseased plots and the adjacent healthy ones showed that the former were deficient in nitrogen and phosphoric acid, and the application of organic manures restored normal conditions. A case of yellowing and abnormal leaf-fall on a large scale was found to be caused by the attacks on the young twigs of *Gloeosporium*, *Phyllosticta*, or *Phyllactena*, or by partial invasion of young branches by *Diplodia theobromae*. Experiments showed that leaf fungi such as *Gloeosporium* can attack the young green shoots. *Cephaleuros virescens* was observed on the leaves of a young tree, but appeared to be harmless. *Phytophthora meudii* has not been observed in Cochin China.

Trunk and branch diseases are more serious than those of the leaves. 'Dryness' of green shoots and branches is of common occurrence. It is usually due to one of the fungi mentioned above. *Diplodia theobromae* is the worst of these, causing 'die-back' and other less clearly defined diseases of which a separate account has been published (*Bull. de l'Inst. Scient. de Saigon*, Nov. 1919). *Corticium salmonicolor* B. & Br. causes less damage in Cochin China than in most other rubber-growing countries, owing to the relatively long dry season which checks the development and spread of the parasite. The mycelium, however, penetrates the outer layers of the wood, and continues its development even under conditions which are unfavourable to its manifestation on the surface. This fact is important as demonstrating the futility of purely external treatment. A fuller account of this disease has been given (*Bull. de l'Inst. Scient. de Saigon*, Nov. 1920).

Phytophthora omnivora, to which the formation of various cankers on the trunks, branches, and tapped surfaces is attributed

in Ceylon and Java [the author presumably refers to *P. fuberi*], has not been observed in Cochin China. In the latter country similar cankers are stated to be due to fungi that normally inhabit the green twigs on the fruit, the chief being *Nectria*, *Fusarium*, and *Gloeosporium*. These cankers are frequently succeeded by a progressive woody encystment of the latex vessels, which takes place under an externally intact cortex, but in which the fungi mentioned are evidently not involved, since it appears to be due to the infection of the latex by a motile bacterium. A similar cause is assigned to the modifications in the cortex on or near the tapped surfaces, consisting of discoloration and the stoppage or great diminution of the flow of latex. ['Brown bast' is evidently referred to.]

Wounds caused by cutting back the 'stumps' used for planting sometimes become infected by common fungi such as *Diplodia*, *Phoma*, or *Phlyctuena*. Only on one occasion was a serious disease in the beds recorded. The cortex of young shoots, not more than 1 to 2 decimetres in height, was deeply corroded by a canker at the level of the soil. The primary cause of this canker was the invasion of the young tender tissues by the mycelium of a *Gloeosporium* or *Cytospora*. The disease may be described as accidental, since the long immersion of the base of these young plants in consequence of exceptionally heavy rains predisposed them to attack. A few days of fine weather brought about an immediate improvement.

SUGAR-CANE. A *Marasmius* greatly resembling *M. sacchari* occurs on diseased canes cultivated by the natives on the muddy dikes of the canals intersecting the west of the country. The attack appears to be due to the use of an excess of organic manures, accompanied by an almost total lack of cultivation. 'Serch' disease was observed in a plantation where a few canes were being cultivated with a view to future extension. The diseased varieties had been imported, but the presence of serch on indigenous canes is already on record in the province of Biênhoà. The disease is not likely to cause much damage as long as a careful selection of resistant varieties, of which there are many available, is made. The varieties referred to above were Pink Bamboo (imported from Hawaii) and Demerara (from Java). Investigations into the origin of the disease indicated that several fungi, *Nectria*, *Hypocrea*, and *Schizophyllum*, produce symptoms similar to those of serch.

COCO-NUT. In December 1920 a serious case of fruit-fall before maturity occurred. The appearance of the fruit suggested a parasitic disease, and this was borne out by the presence of a *Gloeosporium* together with *Diplodia theobromae* on the rind of the fallen nuts, the *Diplodia* being also found on the peduncles still attached to the tree. *Thielaviopsis ethacetica* Went, the conidia of which form abundantly in the central cavity of the dried nuts, might also be suspected to be a contributory cause of the disease. Comparative analyses of the soils of various plots, however, led to the conclusion that the fundamental cause was the insufficient nourishment of the roots, which was remedied by the application of nitrogenous manures. *Pestalozzia palmarum* Cke. occurs frequently on old leaves, rarely attacking young organs. *Diplodia theobromae* develops in the tissues of the petioles, and sometimes

occasions the premature withering of the leaves. A *Nectria* produces a similar disease, which, however, appears to be rare.

COTTON. In December 1920 leaves submitted for examination from Cambodia were found to be affected simultaneously by the insect *Sylepta derogati* and the fungus *Ramularia areola*, producing the disease known as 'false mildew'. *R. areola* also occurred on imported varieties of cotton in the Botanical Garden of Saigon, but left the indigenous varieties practically unharmed. Anthracnose (due to *Glomerella gossypii* (Southw.) Edg.) and a canker of the collar, the cause of which was not determined, were also seen in Cambodia. *Mycosphaerella gossypiella* (Cke.) Atk. is recorded as a leaf-spotting fungus, but does not cause appreciable damage.

CINCHONA. A disease, apparently due to a species of *Guignardia*, attacked young plants in Annam, especially *C. ledgeriana*. It is stated to occur also in Java. The application of copper fungicides did not check this disease, and was injurious to the young plants.

PETCH (T.). **Plant pests and diseases in Ceylon.** *Trop. Agric.*, lvii, 3, pp. 192-194, 1921.

This is a progress report of the division of botany and mycology for the second quarter of 1921.

The diseases of rubber (*Hevea*) reported were:—*Fomes lignosus*, brown root disease [*Fomes lamucoensis*], *Ustilina*, *Xylaria*, and *Diplodia*. Of these, *Xylaria* is practically a new disease, no report of it having come to hand since 1909, when one case occurred. Among the tea specimens there were several cases of *Diplodia*, and one each of the rare maladies caused by *Fomes applanatus*, *Polyporus mesotulpae*, and *Polyporus interruptus*. The 'bitten-off' disease, i.e. the disease in which the roots of tea seedlings appear to have been bitten off, is probably due to a *Rhizoctonia*. This fungus also appeared on young shoots from collar-pruned bushes, which were attacked at the ground level and ringed. But neither its identity nor its parasitism has as yet been clearly established. An undetermined leaf disease of tea, possibly due to bacteria, was first observed in 1914, and occurred again this year in up-country districts. It attacks the young unfolded buds, which usually turn black in patches, though the process may extend to the whole surface and cause complete rot. In the former case the buds develop but the expanded leaves are perforated with irregular holes, or variously scalloped round the margin, this effect being due to expansion of the healthy parts of the leaf, coupled with the drying up and falling out of the attacked portions. The disease seems to be arrested after the expansion of the leaf takes place.

Sorghum growing on the Experiment Station, Peradeniya, has been attacked by *Acrothecium lunatum*, which causes a disease similar to 'wet weather mould', due to *Cladosporium*. It is new to Ceylon, as is also the collar rot of sugar-cane, which has occurred at the same place and is caused by *Hendersonina sacchari*. *Bacillus solanacearum* induced a wilt in young brinjal plants, while a *Phytophthora* found on *Cynometra cauliflora* may be identical with *P. meadii*. Work on the nut-fall and leaf-break in coco-nuts makes it evident that there are several causes, pathological and physiological, and attempts are being made to differentiate between them.

